Winter 2017

Advanced Technology Institute Newsletter
Faculty of Engineering and Physical Sciences

News

HEAD OF ATI HONOURED BY SRI LANKAN PRESIDENT

Professor Ravi Silva, Head of Surrey's Advanced Technology Institute, has been given an award by the President of Sri Lanka for his exceptional contributions to nanotechnology in the country.

The honour was awarded to **Professor Silva** by His Excellency Maithripala Sirisena, President of Sri Lanka, in recognition of the many contributions he has made in the field of nanotechnology which have had a positive impact on industry and society in Sri Lanka.

For the past 20 years, Professor Silva has worked with colleagues in Sri Lanka to promote nanotechnology, helping to establish the Sri Lanka Institute of Nanotechnology (SLINTEC) in 2008 when he was on sabbatical, acting as a science adviser in the country.

In September, Professor Silva also helped to organise the prestigious Science and Technology for Society (STS) Forum with Sri Lanka's Minister of Science, Technology and Research, the Hon. Susil Premajayantha MP. The event brought together over 1,200 international delegates to foster equitable and inclusive development through science, technology and innovation, and integrate Sri Lankan industries into the global value chain.

The ATI addresses the perceived 'grand challenges' in renewable energy, healthcare and information technology. Activities are broadly divided into four research groups: Nanoelectronics, Photonics and Quantum Sciences, Ion Beams, and Theory and Advanced Computation.

We have a number of **postgraduate opportunities for students and sponsors**. Please contact:

- Nanotechnology & Renewable Energy MSc - Programme Director
  Dr Maxim Shkunov maxim.shkunov@surrey.ac.uk
- MPhil/PhD Research – Postgraduate Admissions Tutor
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IN THIS ISSUE

SPRAY PRINTED CRYSTALS TO MOVE FORWARD ORGANIC ELECTRONIC APPLICATIONS

New research published in Nature Communications, conducted by a team of researchers from the ATI and National Physical Laboratory, demonstrates for the first time a low-cost, scalable spray-printing process to fabricate high-quality isolated organic single crystals. The method is suitable for a wide variety of semiconducting small molecules, which can be dissolved in solvents to make semiconducting inks, and then be deposited on virtually any substrate.

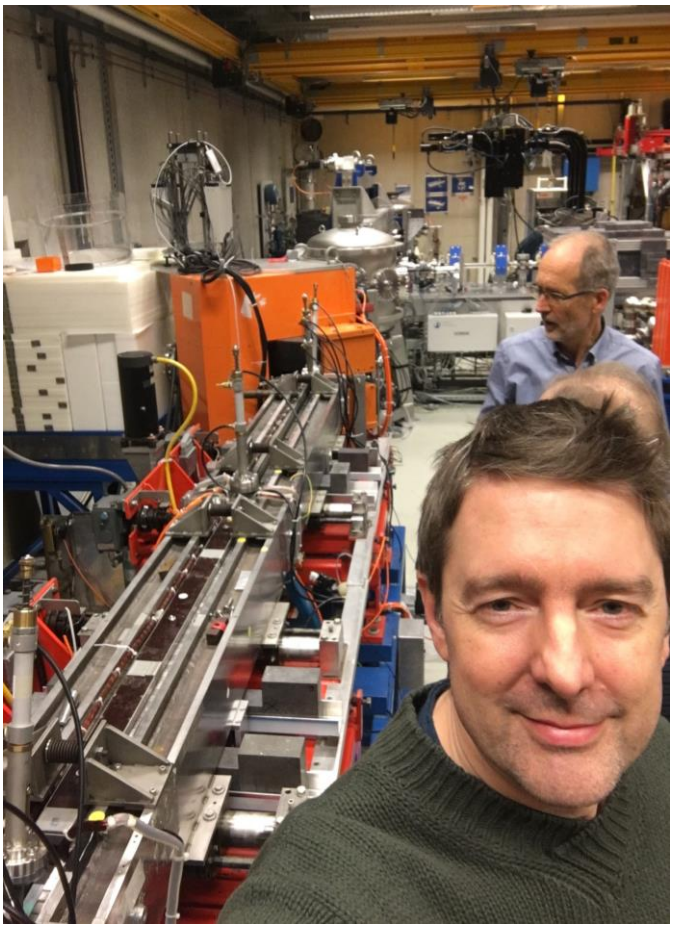
"This method is a powerful, new approach for manufacturing organic semiconductor single crystals and controlling their shape and dimensions," said the ATI's **Dr Maxim Shkunov.** "The key aspect is in combining the advantages of antisolvent crystallization and solution shearing. The crystals' size, shape and orientation are then controlled by the spay angle and distance to the substrate, which govern the spray droplets' impact onto the antisolvent's surface.

Grigorios Rigas, ATI and NPL collaborative PhD researcher and first author, explained: "We can now make single crystals in a much simpler way, entirely at room temperature with a £5 artist spray brush. The technique promises a low-cost route to manufacturing high performance printed electronics."

SURREY-NPL STUDENT WINS IET TRAVEL AWARD

Grigorios Rigas has also won the prestigious IET 2016 Travel Award for his work on innovative printed electronics, and was funded to attend the 2016 Materials Research Society (MRS) Fall Meeting in Boston (USA) in November to present his research on ink-jet printed biomedical sensors to an audience of leading figures from academia and industry.

RENEWAL OF THE EPSRC MID-RANGE FACILITY AT FELIX



A consortium of UK researchers has successfully negotiated renewal of a long-standing collaboration with Radboud University, Nijmegen, for research at the FELIX laser laboratory. EPSRC will fund two beam lines at the Dutch facility, a unique source of light spanning from the infrared to the microwaves. The laser emits much brighter and much shorter pulses than anything currently available in the UK. With it, British researchers are performing experiments from silicon quantum technologies, to astrophysical molecular spectroscopy, to catalysis.

The announcement for the renewal of the EPSRC Mid-Range Facility at FELIX follows hard on the heels of the opening of new one at the same location for research on high magnetic fields. **Professor Ben Murdin** (pictured in the Felix laser vault with Dr Lex van Der Meer) the UK spokesman at FELIX and ATI researcher, said: "The photons produced in Nijmegen have allowed us to look at far more complex motions at the quantum level than we would be able to by ourselves. I am looking forwards to the exciting opportunities provided by the high magnetic field and the FELIX laser. We will be able to not only watch electrons as they move through materials with the laser, but also control the motion in new ways with the magnets. It is wonderful to see that British scientists are looking outwards and able to work with the best available tools wherever they may be, Brexit or not."

THROWING NEW LIGHT ON PRINTED ORGANIC SOLAR CELLS

Researchers at the ATI have achieved record power conversion efficiencies for large area organic solar cells.

In recent years, scientists have been attempting to increase the efficiency of these cells to allow commercial applications such as integration into a building's glass façade, generating electricity to power the building. The research was led by the University of Surrey's Advanced Technology Institute (ATI) in collaboration with Oxford University, Aristotle University of Thessaloniki (Greece), and University of Stuttgart (Germany). The project is part of SMARTONICS, a four-year European Commission FP7 programme aimed at developing large-scale pilot lines for the fabrication and printing of organic polymer solar cells.

The results, published in Advanced Electronic Materials, by Dimitar Kutsarov et al demonstrate that dependencies between the chemical and physical properties of the photoactive layer's building blocks within organic solar cells determine the efficiency of these solar cells. The team used a well-known and low cost electron donating material (P3HT) in combination with an electron accepting material (ICBA) for the photosensitive layer of the organic solar cells. Different ICBA samples with different arrangements of atoms lead to improved spatial arrangement of P3HT and ICBA in their photosensitive blend and lead to varying power conversion efficiencies. Tailoring the fabrication process based on these findings, the research team were able to improve the efficiency of their solar cells from 2.2% up to 6.7%. This is one of the highest efficiencies to have been reported for P3HT blends on a large-area device.

SECRETARY OF STATE OPENS TEST FACILITY DEVELOPED THROUGH SURREY-SME PROJECT PARTNERSHIP

Rt. Hon. Amber Rudd MP, Secretary of State for Energy and Climate Change, officially opened an exciting new test facility which has been developed thanks to a collaborative research partnership between the University's Advanced Technology Institute (ATI) and Department of Physics with Sussex-based SME, Plastipack Ltd. The unique test facility, a world first, comprises of five outdoor 8m x 4m x 1.2m swimming pools located side by side at the Plastipack Headquarters in St. Leonards-On-Sea, East Sussex.

Plastipack is one of the world's leading manufacturers of specialist covering materials for swimming pools: providing solar performance and evaporation control, significantly improving the carbon footprint of pools by reducing the energy and chemicals required to run them. The relationship with Plastipack Ltd has been nurtured by academics from the University's Department of Physics - **Dr Steve Clowes, Professor Stephen Sweeney and Dr Marian Florescu**, with the assistance of Research and Enterprise Support. In July 2012, the partnership embarked on a sKTP (short Knowledge Transfer Partnership) funded by Innovate UK. This 12-month project with Plastipack recruited **Dr Remi Wache** as the KTP Associate to develop the theory of a dual-function swimming pool cover that allows for maximum water heating from solar radiation while blocking the wavelengths that allow photosynthesis, thus inhibiting algae growth.

Drawing upon expertise in photonics and using state of the art optical characterisation, the project demonstrated that an enhanced energy-saving product could be achieved by applying materials science to engineer the required optical properties significantly improving the thermal insulation. The work resulted in submission for a patent for the new EnergyGuardTM product and commercialisation of the product is reinforcing the company's market leading position.

ELECTRIFYING NEWS: ...NANO MODIFIED AEROSPACE COMPOSITES

New research, published in the journal Scientific Report, demonstrates that by growing nanomaterials, specifically carbon nanotubes, on the surface of the carbon fibres it is possible to impart these necessary properties.

The research, conducted at the ATI and the University of Bristol's Advanced Composite Centre for Innovation and Science (ACCIS), shows off the potential of a carbon fibre reinforced plastic to be made multifunctional, while still maintaining its structural integrity. Novel functionality including sensors, energy harvesting lighting and communication antennae can now be integrated into the structure of the composite to usher in a new era in composite technology.

Professor Ravi Silva, Director of the ATI and Head of the Nanoelectronics Centre (NEC) said: "In the future, carbon nanotube modified carbon fibre composites could lead to exciting possibilities such as energy harvesting and storage structures with self-healing capabilities. We are currently working on such prototypes and have many ideas including the incorporation of current aerospace/satellite technology in automotive design." **Dr Thomas Pozegic**, Research Associate in ACCIS and formerly a PhD student at the ATI, explained: "The material that we have developed utilises high-quality carbon nanotubes grown at a high density to allow electrical transport throughout the composite material." Dr Ian Hamerton, Reader in Polymers and Composite Materials in ACCIS, commented: "The research has shown that carbon nanotubes can significantly enhance the thermal conductivity of carbon fibre composites. This will have wide-reaching benefits in the aerospace industry, from enhancing de-icing solutions to minimising the formation of fuel vapours at cruising altitudes."

Capacity and Facilities

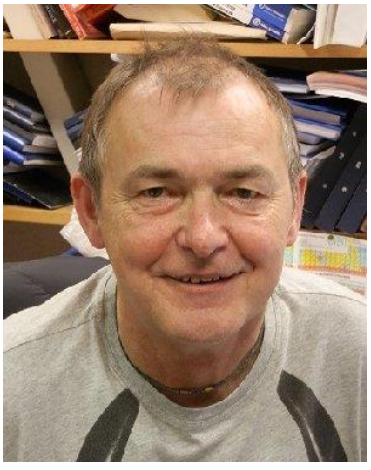
- Expanding our capability in Quantum Technologies with an EPSRC £3m grant "SIMPLE", (Single Ion Multispecies Positioning at Low Energy)
- Strengthen our analytical capability with the new Forensic tool **(Webb, Bailey)**
- New Plasma FIB **(Cox)**
- Progress our networking with the outside world with the fantastic new Surrey-NPL South Hub on the second floor of the ATI.
- n3m Metrology and Modelling lab and EPSRC grant (£2m, **Aaen, Florescu, Ginnossar, Silva**)

STOP PRESS

IBC – Professor Roger Webb and colleagues within the IBC won an amazing £8.8m continuation of the IBC research grant for the next five years.

Inaugural Alan Rogers Innovation Award 2017 is awarded to Dr Chris Mills, Dr Imalka Jayawardena and Hashini Thirimanne for their Project "**U**ltra **S**ens**I**tive Pi**X**el **X**-ray **D**et**E**cto**R** – (µSIX²ER)"

Staff news



In memory:
Professor Russell Gwilliam (Professor of Semiconductor Process Engineering and Director of Technology for Surrey IBC). Russell had been a key member of the community for more than 30 years and was highly respected in his field. He played a pivotal role in driving forward world-class research at the ATI and was a true inspiration to undergraduates, postgraduates and colleagues.

Retirement:
Prof Kevin Homewood – Professor of Semiconductor Optoelectronics
Dr Manon Lourenco – Research Staff

Left: for a career at Manchester University
Prof Richard Curry – Professor of Photonics